

population that it has been impracticable to transmit their energy to localities containing the heart of our industries, and in many instances, particularly among the Western mountains, they are so inaccessible as to make it difficult or inconvenient to establish industries about these sites or within reach of electrical power transmission. But with wireless transmission of power the energy of the waterfall of the Columbia River—which by the way, amounts to seven or eight million horsepower—can be employed to run the motors of industry, to light and heat homes and cook food on the Atlantic seaboard as readily as on the Pacific, in Portland, Maine, as well as in Portland, Oregon; or the five million horsepower from the Sacramento River, in Manila as easily as in San Francisco. There is millions more than enough horsepower going to waste in the streams of the North Pacific group to turn every wheel of industry and move the traffic of every railroad in the country; and with the advent of wireless power it will be developed, along with other millions of hydroelectric power elsewhere, as consumption creates a demand for it.

The greatest power site in the world, Zambesi Falls, was recently discovered in the until then unexplored heart of Africa. Over its brink has gone to waste thirty-five million horsepower every minute of each day for centuries, enough energy to provide a large part of the world with power, more than enough to supply the commerce and industry of the United States. Because of its isolated location it is useless to mankind, and will be until wireless power makes it possible to set the wheels of a thousand industries spinning anywhere on earth with its magnificent energy.

WHILE the general public has not been taken into Tesla's confidence concerning the progress of his work in the perfection of his system for the wireless transmission of power, scientific and electrical engineers in all countries have followed closely and with intense interest such developments as he has revealed to the technical world. For obvious reasons, however, it would not be prudent to disclose the actual working details of the system, or the specific nature of apparatus to be employed, until such time as he may elect to place his transmitter on the market for commercial purposes.

"There is," says Tesla, "much misunderstanding in regard to my wireless system. Some believe that the transmission is effected through the air, and others that the currents go only through the earth. The fact is both media serve as vehicles of energy. The current passes through the earth; but an equivalent electrical displacement also occurs in the air, exactly as when the transmission is effected through a single wire without return; a principle the practicability of which I demonstrated in my earlier investigations.

"By this system," he continues, "wireless power can be transmitted with absolutely the same facility to the antipodes as it can to a distance of a few blocks. The quantity of energy the transmitter delivers is immaterial; but, in view of the fact that the earth is immense, and that there are practical limits in the amount of energy collected in any individual receiver, it is necessary to have a very powerful transmitting plant.

"However," he explains, "the volume of energy—the indicated horsepower of the generating plant—will not in the least affect the limit of transmission. That is, a plant generating two hundred horsepower will transmit its energy to the same unlimited terrestrial distance as that of a plant generating two hundred thousand horsepower. Neither will the energy or power decrease in efficiency as the distance of transmission increases, as is the case with electrical energy transmitted by wire. The efficiency of transmission will be the same, irrespective of the distance or the amount.

"When conveying power through a wire," Professor Tesla points out, "a certain loss is incurred, due to the resistance of the conductor; but the earth is a conducting body of such enormous dimensions that there is virtually no loss, so that distance means nothing. To the average intelligence this will appear incomprehensible. We are continuously confronted with limitations, and those truths which are contradicted by our senses are the hardest to grasp. For example, one of the most difficult tasks was to satisfy the human mind that the earth rotated round the sun; for to the eye it seemed just the opposite."

IN regard to the cost of wireless power, an estimate is made that places it at about one-sixteenth that of the present means and sources of supply. At any rate, Tesla says that it will be far cheaper than any other source known to man. "With wireless energy," he continues, "we could avail ourselves of the waste power of the present: the transmission would involve but little expense, and the apparatus would be of the simplest and cheapest."

The cost of wire transmission varies with the ratio of distance between point of generation and consumer, as determined by investment in and maintenance of conveying mains, which increases with distance. Also, over long lines, as from Niagara Falls to points some two hundred miles distant, the loss of current increases with each mile, and would, if the line were carried far enough, so decrease in volume that eventually the current would lose practical power producing energy. With the most improved means of wire transmission the limit of distance is placed by the most optimistic engineers at not much beyond five hundred miles. With wireless transmission there will be no limit, except that of terrestrial space, nor will the cost be greater in transmitting power to the antipodes than to the factory a block distant from the generating plant.

Tesla is assured that it will be absolutely unnecessary to have relay or transforming stations, since the consumer can receive the power direct, no matter where he

may be situated. Also, there will be no conflict or interference of currents. Two factories situated in the same block, for instance, or two parallel railroads, or two competing steamship lines, could receive their power independently from separate sources, one from Africa, the other from Niagara. And his perfected system of positive selectivity will absolutely prevent an unscrupulous consumer from stealing his power from the air, any more than he could use the key to his barn door for manipulating the time lock on a bank safe, so complete will be the individualization of currents. Also, this eliminates the element of power monopoly.

IN the field of transportation wireless power will work some of the greatest changes in things as they are. First among all, the steam-driven train and ship will pass into history along with the cradle, the flail, and the spinning wheel. And the noisy chugging of the smoking, foul smelling automobile will soon be a memory.

Professor Tesla has so far perfected his original system of isolation in the transmission of wireless energy that he is able to control, for instance, an automaton in the form of a miniature submarine ship, which he can readily direct and maneuver at will,—starting, stopping, speeding, turning, reversing, diving, rising, by the simple manipulation of wave impulse.

"When my system is complete," says he, "a crewless ship may be sent from any port in the world to any other port on the Seven Seas, propelled by wireless energy from a power plant anywhere on the face of the earth, and controlled and maneuvered absolutely and positively by telautomatics."

The ship in its actual position on the sea would not alone be visual to the telautomatic operator, but there also would be reproduced through the visualizing apparatus or aërocamera a detailed and faithful scene picturing her surroundings and the conditions of sea and weather.

Given wireless power and telautomatic control of ships at sea, that ever menacing *bête noire* of the mariner, the danger of collision in fog and night, or of going on the rocks or shoals, will be eliminated. For the crewless ship the operator, seated in his despatching office on land, surrounded by sensitive devices, with which any point he may elect of earth or sea may be visualized before him, would also "feel" the approach of another ship or the proximity to an iceberg or shoals, when he would easily deflect the course of his ship from danger. Ships carrying only cargo will be crewless, and they will be as water- and air-tight as a submarine, made buoyant by vacuum, and practically nonsinkable.

The future of wireless power development may render it folly for any nation to have afloat a vessel of war. The secret of another nation's scheme of selectivity might be disclosed to the enemy, when the guns of their own vessels might be turned against sister ships and a whole fleet destroyed by shells from their own guns, or their magazines might be exploded by the enemy at will. However, should there be battleships in the wireless future, they will be crewless. They will be maneuvered, their guns will be loaded, aimed, and fired, and their torpedoes discharged with unerring accuracy, by the director of naval warfare seated before a telautomatic switchboard on land.

"The time will come, as a result of my discovery," said Tesla, "when one nation may destroy another in time of war through this wireless force: great tongues of electric flame made to burst from the earth of the enemy's country might destroy not only the people and the cities, but the land itself. I realize that this is indeed a dangerous thing to advocate. At first thought it might mean the annihilation of the nations of the world

by evilly disposed individuals. The public might at first look upon the perfection of such an invention as a calamity. We say that all inventions assist the criminal in his work. Today the safe burglar despises the use of dynamite, turning to electrical contrivances to cut the lock from a safe. It is fortunate for the world, therefore, that ninety per cent. of its people are good, and that only ten per cent. are evilly disposed: otherwise, all invention might be turned more greatly to evil than to good."

As with the ships of the sea, so also the gigantic freight ships of the aerial highways will be controlled, lifted in air, sent whizzing along at two hundred miles—the through express and mail possibly at three or four hundred miles—an hour, lowered to scheduled landing places en route, the progress of the discharge and loading being visible to the operator, and again raised and put to flight by the telautomatic control despatcher at the headquarters of the line. The possibilities of the part crewless warships of the air may play by dropping earth-rending bombs upon the cities of the enemy, is obvious.

WITH wireless propelled passenger air carriers, having decks closed or protected against the strangling, lung drowning rush through the air, traveling three or four hundred miles an hour through routes in high altitudes, one may have a six o'clock dinner in New York and breakfast next morning in San Francisco or London or Paris, or have luncheon in San Francisco and tea next day in Canton or Tokio.

The airship of Tesla's invention will be neither aëroplane nor dirigible, nor will it have wings or gasbags or propeller blades. All these things, he says, are impossible in the construction of a commercially practicable airship. The aëroplane he classes as no more than an amusing toy, a vehicle for exhibition by the venturesome sportsman; nor will it ever be anything more, because in its essential principles it has irremediable flaws that are absolutely fatal to commercial success. Tesla's airship will be proportionately as substantial, as stanch and dependable, and altogether as airworthy as the steamship of today is seaworthy. It will maintain a steady, even keel, and will not be in the least affected by air currents or any sort of weather conditions.

The size of these ships of the air may be limited only by the area of accommodations provided for their landing. Or they may be made small enough, being so easily and simply handled, that the school girl and boy may ride them to and from school, and in greater safety than walking in the city streets. The single or double or triple passenger aërocar of Professor Tesla's type will be more popular, too, for individual and independent transit, either for business or pleasure, than was the bicycle in its heyday, or the gasoline automobile at its best. Then the city commuter of the future may go and come between business and residence on his wireless aërocar, and he may go many miles farther afield, into the uncrowded hills and valleys and sea and lake shore, to make his home.

HOWEVER, before the general public is fully educated to the popular use of aerial navigation as a common utility, wireless power will have been generally, if not universally, applied to the railroads. It is very probable, in fact, aside from the industries and ocean commerce, that wireless power will find its first application to rail traffic. It will be an ideal source of power, and the resulting advantages and economies will be, more truly than tritely, too numerous to mention in anything less than a volume.

Millions of tons of coal will be saved that are now consumed in hauling fuel to coaling points. The use of hydroelectric power will conserve the coal resources. The ponderous, track wearing steam locomotive will be abandoned to the scrapheap. The smoke and soot and grime of travel will be eliminated. Direct wireless connection with the motors under each car will discard the deadly third rail and the hundred-ton electric engine. Wireless controlled safety devices will make collision impossible, and the wireless trains will provide every comfort and electrical convenience of the latest thing in hotels.

The maximum of speed will be determined by the capacity of the track to withstand strain. And wireless power will make it cheaper to cut through mountains, fill valleys and bridge cañons, than to operate on curves and grades. With these abolished and with roadbeds laid on approximate levels, straightaway as the crow flies for hundreds of miles, and with Tesla's gyroscopic mechanism to provide stability and prevent lateral impact, two or three hundred miles an hour may be maintained with safety and comfort. Then one might have breakfast overlooking the Golden Gate and attend a Broadway theater in the evening, and be home again before noon the next day.

Wireless power will make it possible to despatch crewless, light, cigar shaped steel mail cars on curveless, gradeless elevated or overhead tracks across country at an inconceivably terrific rate of speed. It may be telautomatically operated from a terminal switchboard, from where the train may be started, speeded, and stopped, or a "local" car dropped off and another taken on without pause at cities or junctions en route. Letters posted in New York in the morning may then be handed to the addressee by the postman in San Francisco on the afternoon delivery, or to the Chicago business man when he comes down to his office in mid-forenoon.

ONE of the great handicaps to the existing system of wireless telegraphy is the serious interference with messages on account of imperfect control of selectivity, secured principally by tuning. Realizing that such inter-



Nikola Tesla.